XVII. Mr. Alfred D. Millar's *Experimental Breeding from the Ova of the Natalian forms of the Nymphaline Genus* Euralia. By Roland Trimen, M.A., F.R.S., etc.

[Read June 1st, 1910.]

Plates LXI—LXV.

In a preliminary note communicated to the Society through the good offices of my friend Professor Poulton on March 2, 1910 (see Proc. Ent. Soc., 1910, p. xiv), I had the pleasure of making known the highly interesting results of my friend Mr. Alfred D. Millar's experiments in breeding from the ova of the three forms of *Euralia* known to inhabit the coast-belt of Natal, and hitherto recognised as distinct species, viz.—*E. wahlbergi*, Wallengr., *E. mima*, Trim., and *E. deceptor*, Trim. I now propose to give the promised full account of these experiments, as illustrated by the specimens, photographs, and carefully recorded observations furnished by Mr. Millar.

Euralia is nearly allied to *Diadema* (= *Hypolimnas*), and was founded by Westwood in 1850 on two West African species (*dubia*, Palisot, and *anthedon*, Doubl.) having the discoidal cell of the hindwings open. Other distinctions of *Euralia* are the narrower head, considerably longer and gradually clavate antennae, and the anal angle of the hindwings more prominent in the male. The *larva*, as Mr. Millar observes, differs from that of *Diadema misippus* in its considerably longer spines generally, and still longer pair of spines or horns springing from the top of the head.

Euralia, in the advanced development of its mimicry of the Danaine genus *Amauris*, almost equals the *curytus*-group of another Nymphaline genus, *Pseudacraea*, with its similar wealth of close imitation of the Acraeine genus *Planema*. I have recently commented on the latter mimicries in my appendix to the Rev. St. Aubyn Rogers' "Bionomic Notes on British East African Butterflies,"* pointing out the persistency, exactness, and completeness with which these *Pseudacraeae* reproduce the pattern and

* Trans. Ent. Soc. Lond., 1909, pp. 551–2.

colouring of their models, the very variable *Planemae*—every variation in both sexes appearing to be faithfully copied throughout tropical and sub-tropical Africa wherever the genus *Planema* prevails. I mentioned that of the very limited number (about 20) of provisionally recognised species and sub-species of *Planema*, 10 were already known to be thus deceptively mimicked by corresponding forms of *Pseudacraea*, and expressed the opinion that other parallel cases probably remained undiscovered. Similarly, among about 26 provisionally admitted species and subspecies of *Amauris*, I find 8 cases of unquestionable mimicry by forms of *Euralia*.

E. mima and *E. wahlbergi* are the representatives in the east and south-east sub-region of the West African *E. dubia*, Palis., and *E. anthedon*, Doubl.,* and like these latter mimic very accurately species of the Danaine genus *Amauris* widely differing from each other in appearance. The very variable *E. dubia* seems to follow in its variations *A. egialea*, Cram., *A. psyttalea*, Plötz, *A. hecate*, Butl., and *A. tartarea*, Mab., inhabiting the same country; but *E. anthedon* seems to be constant in mimicking *A. niavius*, Linn. In the same manner the eastern and south-eastern *E. mima* imitates closely *A. albimaculata*, Butl., and —very rarely—*A. echeria*, Stoll; while *E. wahlbergi* copies *A. niavius*, sub-sp. *dominicanus*, Trim.† The third Natalian form of *Euralia*—*E. deceptor*, Trim.—is more prevalent on the tropical East African coast up to the equator, and imitates in its turn, with equal accuracy, *A. ochlea*, Boisd., which has the same geographical range. Since its dis-

* Aurivillius (Ent. Tidskr., 1894, p. 282) notes a Camaroon ♂ *Anthedon* and a Kaffrarian ♂ *wahlbergi* which nearly approximated in the width of the hindmarginal border of the hindwings, and expresses the opinion that this shows them to be local races of the same species. He also mentions (*l. c.*, p. 281) that a ♀ *E. dubia* var. *cerberus*, Auriv., from Camaroon has the spots of the forewings quite like those represented in my figure of *E. mima* from Natal in Trans. Linn. Soc. Lond., xxvi, pl. xliii, f. 7 (1869).

† In Madagascar, a variation of *E. wahlbergi*, named *madagascariensis* by Mabille, appears to be modified in simulation of *Amauris nossima*, Ward, inhabiting the same island; and a form intermediate between *E. dubia* and *E. mima*, the *drucei* of Butler, prevails—although there is no known *Amauris* from Madagascar that could be its model. It seems possible that the dimorphism now represented by *madagascariensis* and *drucei* had been developed and established in the continental-African ancestors of these forms before their range had extended to Madagascar.

covery in Natal in the year 1873, *E. deceptor* has hitherto remained very much rarer there than *wahlbergi* and *mima*.

The obviously intimate affinity of these three forms of *Euralia* in Natal was brought to notice by me as far back as 1873 in the "Transactions" of the Society; together with a note of the fact that *E. mima* ♂ and *E. wahlbergi* ♀ had once been taken paired. Although, in the long interval since that date, Mr. Millar, Mr. C. N. Barker, Mr. Guy A. K. Marshall, and other entomological observers in Natal, have called attention to a few other cases of the pairing of the latter two forms, as well as to various details of habits, distribution, etc., which supported the view of their species-identity—no advance of importance had been made towards settling the question until the earlier part of last year, when Mr. Millar, having ascertained their common food-plant, resolved to test the case by breeding from the ova of all three forms.

First Experiment.—*Offspring reared from ova laid by two examples of* Euralia deceptor.

The food-plant—a species of stinging-nettle identified by Mr. J. Medley Wood as belonging to the genus *Fleurya*—was potted and enclosed with netting, so as to be at hand for the safe rearing of the anticipated larvae. On March 21, 1909, at Mount Edgcumbe, near Durban, two ♀♀ *E. deceptor* were captured in the act of ovipositing, and placed on the net-covered food-plant, where they together during the 24th and 25th laid 139 eggs, from all of which the larvae were hatched by March 29. On the 31st the young larvae were dark-brown, except towards each extremity, where the colouring was pale semi-transparent greenish-yellow, and they were closely covered throughout with minute dark spines. On April 5, after moulting, the body generally had changed to shining-black, and the strong spines towards the front of each segment, as well as the pair of long spines or horns on the head, were developed; but not until the 15th, after the final moult, was the full colouring and development attained, in which the body was velvety-black with segmental very narrow anterior elevated pale-yellowish transverse bands or half-rings, bearing numerous acute spinulose brownish-yellow spines, and the head was shining yellowish-brown, with the two long divergent spinulose spines or horns black. The change to pupa began on April 19; 60 pupae were

disclosed by the 24th; and all the remaining larvae had pupated by the 29th—with the exception of six taken for preservation as inflated dried specimens.

The appearance of the imagines began on May 2, and continued for 13 days, ending on the 14th. The ♂♂ took the lead, 29 of that sex only emerging during 2nd to 4th; the ♀♀ came out in smaller number than the ♂♂ (7 to 17) on the 5th and 6th, but in larger number than the ♂♂ (45 to 24) from the 7th to the 11th; while on the last three days, 12th to 14th, ♀♀ only emerged to the number of 5. The total number of imagines bred from the 139 ova deposited by the two *deceptor* mothers was thus 127 (70 ♂♂ and 57 ♀♀); 4 ova appear not to have hatched, 2 larvae died, and 6 larvae were preserved. Only 1 imago emerged with crippled or deformed wings. The illustration (Plate LXI), reproducing a photograph taken by Mr. J. H. Burn of Durban, represents in miniature the whole imago progeny of the two *deceptor* mothers, with the exception of the deformed example just mentioned and three others which were damaged in setting.

The very small percentage of loss in rearing this large *deceptor* progeny in confinement would seem to point, in the case of a butterfly so rarely taken in Natal, to the existence of severe persecution or other adverse conditions affecting the insect when at liberty in that country. The mothers under notice were fairly prolific, and the offspring reared in confinement under protection were, with only one exception, fully developed and richly coloured. Mr. Millar writes that "*deceptor* is one of the rarest of our South African butterflies, and during my collecting (now extending over 35 years) I have not taken a dozen good specimens." I have of late years inclined to the belief that, like several other species of butterflies now found in Natal, *deceptor* is a recent immigrant into that country that has extended its range along the coast from the northward. It is—especially as regards the ♀—so pronounced a mimic of *Amauris ochlea*, that in its imago state this form should be shielded from excessive persecution by insectivores; and one is led to suppose that its scarcity in Natal—where its food-plant does not seem to be rare—may be due to enemies attacking the larva or pupa. A butterfly of this size, so very conspicuous and striking in its pattern and coloration—and with the unusual character of the considerably larger ♀ being more brightly tinted than the ♂

on the upperside of the wings—could not escape the notice of collectors in Natal, if it were anywhere numerous or frequent in its appearance.

On examining with a lens the photographed series—68 ♂♂ and 55 ♀♀—of the offspring of the two ♀♀ *deceptor*, one is struck with the very slight amount of variation exhibited by either sex. The specimens are so crowded in the photograph that the hind-marginal area of the hind-wings is more or less concealed except in the last example in each of the nine rows, and in the three next lower examples in the fourth row; but it happens to be on that part of the upperside that most of what little variation there is occurs, viz. as regards the development or suppression of the incomplete hind-marginal series of thin white lunules, and sub-marginal series of 4–5 small white spots—of which the former alone sometimes appear in the ♂, while the latter accompany the former in many examples of the ♀. This variation is well shown in the six ♂♂ and in six ♀♀ from the *deceptor* progeny forwarded to me by Mr. Millar. This constancy to type in so considerable a number of offspring from two mothers is opposed to my long-held opinion that *E. deceptor* would prove to be conspecific with *E. wahlbergi* and *E. mima*. Moreover, the full-grown larva of *deceptor*—as shown by the dried specimens and numerous cast skins just before pupation received from Mr. Millar—differs from those of the two other forms in having the cephalic horns black instead of yellowish-brown and abruptly clavate at the tip, and also in having the pale-yellowish segmental elevated half-rings much narrower and in places discontinuous between the expanded bases of the spines springing from them. Mr. Millar notes that these differences were constant in the whole number of *deceptor* larvae reared. It is, however, worth recording that the first of these distinctions, viz. the blackness of the cephalic horns, has been observed by Mr. Millar to mark also an *earlier stage* of the larva of *wahlbergi* and *mima*, both head and horns as well as the body spines then being black. This is shown by a younger inflated larva-skin sent to me by Mr. Millar.

Whether the living pupa of *deceptor* presents any noticeable difference from that of *wahlbergi* or *mima* I cannot say; Mr. Millar notes none; and a dead example and six skins of the former exhibit no distinctions that I can detect from three pupa-skins of *wahlbergi* and three of

mima—all received with the imagines in Mr. Millar's consignment.

Second Experiment.—*Offspring reared from ova laid by one example of* Euralia wahlbergi.

On the same date (March 21, 1909) as that on which the two ♀ ♀ *deceptor* were captured, Mr. Millar observed a ♀ *wahlbergi* ovipositing on and in the immediate proximity of *Fleurya* plants. He at once followed up this example, and carefully collected ten eggs laid by her, securing them consecutively as they were deposited. All these eggs hatched on the 25th; and on the 31st the young larvae were noted as being dark-blackish, with short black spines. On April 5, after moulting, the larvae were quite black, with on each segment, placed anteriorly, a very thin transverse yellowish band or half-ring; the spines, springing from these half-rings, were more developed, but still black; and the two long divergent cephalic horns were fully formed and also black. The moult of April 10 was followed by a great change in the aspect of the larvae, the segmental yellowish half-rings being wider and more conspicuous, and the head and its horns, together with the spines, the legs and the pro-legs, being all brownish-yellow. On the 14th, five of these larvae pupated, and the remaining five on the 17th. One of the pupae died; but all the rest produced the imago in the following order, viz.:—

April 24—*wahlbergi*-form, 1 ♂.
„ 25—*mima*-form, 3 ♂ ♂.
„ 26—*mima*-form, 1 ♂, 1 ♀.
„ 27—*wahlbergi*-form, 1 ♂, 1 ♀.
„ 29—*wahlbergi*-form, 1 [deformed].

Total offspring of a single example of the ♀ of the *wahlbergi*-form:—4 *wahlbergi* (2 ♂ ♂, 1 ♀, 1 sex undetermined), 5 *mima* (4 ♂ ♂, 1 ♀).

This extremely interesting result, clearly demonstrating the species-identity of the forms *wahlbergi* and *mima*, is the more striking because of the small number of the brood being not far from equally divided between the two forms, and at the same time including both sexes of each form. Mr. J. H. Burn's photograph (reproduced on Plate LXII) gives in miniature all the examples of this brood, with the exception of the deformed one—the sex of which was not noted—and also dried specimens of two full-grown

and one half-grown larvae, and of one dried pupa and eight pupa-skins.

Third Experiment.—*Offspring reared from ova laid by one example of* Euralia mima.

In remarkable contrast to the result just described was that obtained by Mr. Millar from the ova (39) laid, about March 26, 1909, by a single ♀ of the *mima*-form captured a day or two previously. These ova all hatched by April 3, and the larvae presented the same appearance, and went through the same changes after their moults as those above noted in the case of the larvae hatched from ova laid by a ♀ of the *wahlbergi* form; Mr. Millar being unable to detect any difference whatever between the larvae of the two batches. With the exception of two killed for specimens, the whole of the larvae from the *mima* ova pupated on April 29, and of the 37 pupae 4 died. The emergences of the perfect insects were as follows, viz.:—

May 6—	3 ♂♂	— *mima*-form.
„ 7—	2 ♂♂,	1 ♀ do.
„ 8—	8 ♂♂,	2 ♀♀ do.
„ 9—	4 ♂♂,	3 ♀♀ do.
„ 10—	1 ♂	— do.
„ 11—	—	2 ♀♀ do.
„ 12—	1 ♂	— do.
„ 13—	1 ♂	— do.
„ 14—	3 ♂♂,	1 ♀ do.
„ 17—	1 ♂.	

Total, 24 ♂♂, 9 ♀♀, *mima*-form.

The entire series (33) of this brood consisted of the mother's form (*mima*) only; not a single example of either sex—as may be seen from the collective view of them in Mr. Burn's photograph, reproduced in Plate LXIII—showed any divergence towards or indication of the characters proper to the *wahlbergi*-form.

In view of the almost equal emergences of both *wahlbergi* and *mima* in the brood from eleven ova of a single *wahlbergi*, Mr. Millar experienced surprise and disappointment at this unexpected result. On receipt of his accidentally very long-delayed letter of July 6, describing these breeding experiments, I wrote (December 31, 1909)

to express the hope that he would repeat, if possible, a breeding from *mima* ova, as I thought it highly probable a second result would prove to be quite different from the first one; but I learned subsequently that he had already anticipated my suggestion.

Fourth Experiment.—*Offspring reared from ova laid by a second example of* Euralia mima.

On November 21, 1909, Mr. Millar met with a ♀ *mima* ovipositing at Mount Edgcumbe, and secured consecutively eleven eggs one by one as soon as laid. These were carefully placed on the food-plant and kept under regular observation; they all hatched, and the larvae duly fed up and pupated. Without exception the pupae all yielded the imago, the butterflies emerging in the following order, viz.:—

December 19—*mima*-form, 1 ♂.
„ 20—*mima*-form, 3 ♂♂.
„ 20—*wahlbergi*-form, 2 ♂♂.
„ 22—*mima*-form, 1 ♂, 3 ♀♀.
„ 22—*wahlbergi*-form, 1 ♂.

Total offspring of a single example of the ♀ of the *mima*-form: 8 *mima* (5 ♂♂, 3 ♀♀), 3 *wahlbergi* (♂♂).

This second result of breeding from the ova (11) of a single *mima*—in such strange contrast to the earlier one in which exclusively *mima* was obtained from between three and four times as numerous ova (39) of a single example of the same form—conclusively confirms the result of the converse experiment described above (p. 503), in which 4 (2 ♂♂, 1 ♀, 1 sex undetermined) of the *wahlbergi*-form, and 5 (4 ♂♂, 1 ♀) of the *mima*-form were produced from 9 of the 10 eggs laid by one *wahlbergi*. It places beyond question the fact so long suspected but until 1909 never proved, of the absolute species-identity of the two forms under notice;* and it incidentally illustrates the

* Evidence exists to show that my friend and correspondent, Mr. William D. Gooch, who collected largely in Natal in the years 1873–78, and attended specially to the larvae and pupae of Lepidoptera, was close upon discovering the species identity of the two *Euraliae* in question. As I mentioned in "S.-Afr. Butt.," I, p. 281 (1887), in Mr. Gooch's extensive series of drawings and notes, there are two pencil outlines and written details of a larva stated to have resulted in "*Euralia mima* or *dubia*," and one of the figures of the larva is represented on the food-plant, which is unmistakably a stinging-nettle.

wisdom of not resting content with one test experiment only, when its result runs counter to that of a previous experiment in the same field. In this case, when the numerous progeny of the *mima* taken in March 1909 turned out to be without exception of the same form in both sexes as the mother, a very imperfect knowledge of the actual state of things would have been gained if that single experiment of breeding from ova of *mima* had been accepted as conclusive in its result, and so remained unchecked by repetition.*

As indicated briefly in my preliminary note (*l. c.*, p. xv), the case of *E. wahlbergi-mima* agrees with that of another Nymphaline butterfly in Natal—*Charaxes zoolina-neanthes*,† but at the same time differs very strikingly by exhibiting in addition close mimicry of two wholly distinct and very differently marked and coloured species of the protected genus *Amauris*, and thus presents the first recorded instance of *bi-sexual mimetic* dimorphism occurring within the limits of one and the same species. In the *Charaxes* mentioned there is no approach to mimetism, the colouring and marking in both the *zoolina* and *neanthes* forms being inconspicuous—especially in the latter—and on the underside cryptic, and this makes it difficult to discern what the *Charaxes* gains by its bi-sexual dimorphism; whereas in the *Euralia* the advantage of that condition in combination with close mimicry of two such dominant distasteful Danaines as *Amauris niavius dominicanus* and *A. albimaculata* is manifest.

In considering the very differing proportion of the two forms of *Euralia* in the respective progenies reared from the *wahlbergi* mother and the two *mima* mothers by Mr. Millar, it is well to bear in mind that in no one of the three cases in question is it known to which form the

* Mr. Millar has presented the progeny resulting from this fourth breeding experiment, viz. 8 *mima* and 3 *wahlbergi* from ova of a single *mima*, to the unrivalled bionomic series in the Hope Department of the Oxford University Museum; and Prof. Poulton has most kindly contributed the excellent photograph of them by Mr. Alfred Robinson, which is reproduced in Plate LXIV.

† See Mr. G. F. Leigh's interesting accounts in Proc. Ent. Soc. Lond., 1908, pp. lxiv, lxv (with comments by Mr. G. A. K. Marshall, Prof. Poulton, and Dr. K. Jordan), recording the breeding of both *neanthes* and *zoolina* from ova of a single *neanthes*, and in *op. cit.*, 1909, pp. xlix, l, the converse breeding of both forms from ova of a single *zoolina*.

male parent belonged—pairing having ended before capture or observation of the female. Moreover, it is seldom indeed that all the ova normally laid are obtained; a wild female watched or captured, unless immediately or very soon after pairing, having usually already oviposited to a greater or less extent; so that, in a dimorphic or polymorphic offspring, the full relative numbers of the sexes and of the respective forms born from one and the same mother cannot be strictly ascertained. The possible pairings within the limits of the sub-species *Euralia wahlbergi-mima* are four, viz.:—

1. ♂ × ♀ *wahlbergi*-form.
2. ♂ × ♀ *mima*-form.
3. ♂ *wahlbergi*-form × ♀ *mima*-form.
4. ♂ *mima*-form × ♀ *wahlbergi*-form.

Of pairing No. 1 (both sexes of *wahlbergi*-form), Mr. G. F. Leigh (Proc. Ent. Soc. Lond., 1906, pp. lv and lvi) has recorded two cases that came under his personal notice, viz. one on December 16, 1904, and the other on January 23, 1905.

Of pairing No. 2 (both sexes of *mima*-form), there is the instance of the very closely-similar sexes taken by the late Col. N. Bowker (and published in my "S.-Afr. Butt.," I, p. 285, 1887); and also Mr. Leigh's record (*l. c.*) of seeing two *mima* paired on January 27, 1905.

Of pairing No. 3. (♂ *wahlbergi*-form with ♀ *mima*-form), I have no definite instance; but in the "Entomologist" for 1882 (p. 9), Mr. A. J. Spiller, a keen collector and observer, mentions that in Natal he had taken the ♂ *anthedon* (= *wahlbergi*) mated with the ♀ *mima*, and *vice versâ*.

Of pairing No. 4 (♂ *mima*-form with ♀ *wahlbergi*-form), there are two authenticated cases, viz. Capt. H. C. Harford's (published by me in Trans. Ent. Soc., 1873, p. 107, *note*, and in "S.-Afr. Butt.," I, p. 283), and Mr. H. M. Millar's in July 1890.*

The occurrence of certainly three, and most probably

* Mr. A. D. Millar, who communicated this case to me at the time, now writes:—"I have seen *mima* and *wahlbergi* three times paired, but did not note and cannot remember which form was the ♂ and which the ♀." Mr. Millar sent me the ♀ *wahlbergi* of the 1890 case, with the information that his brother, Mr. H. M. Millar, had captured it paired with a ♂ *mima*.

all four, of these possible pairings in nature suggests the idea that an important determining influence on the discrepant results of rearing from ova to imagines the offspring of a ♀ of the *wahlbergi*-form, and (at different times, between four and five months apart) the offspring of two ♀ ♀ of the *mima*-form, may perhaps be found in similarity or dissimilarity in each case of the two parents; that the crossing of the forms may yield a progeny composed of the two different forms in varying proportions; while such a result as the thirty-three *mima* (24 ♂ ♂ and 9 ♀ ♀) exclusively from one mother of the *mima*-form may be traceable to the mating of similar parents.

At the same time, it should not be forgotten that, in the case of *Papilio dardanus* sub.-sp. *cenea*, where the ♂ is non-mimetic and, though varying considerably within moderate limits, constant to one coloration and pattern, the female offspring of two individuals of each form of the trimorphic and tri-mimetic ♀ has been proved, by Mr. G. F. Leigh's breeding experiments in Natal,* to present very great discrepancy in the proportional representation of the three forms. In the two cases of the predominant *cenea*-form of ♀, the ♀ progeny reared was respectively 24 *cenea* and 3 *hippocoon* in one case, and 15 *cenea* and 1 *hippocoon* in the other; in two cases of the rarer *hippocoon*-form of ♀ the ♀ progeny was respectively 8 *cenea*, 3 *hippocoon*, and 3 *trophonius* in one case, and 13 *cenea* only in the other; while, in two cases of the scarce *trophonius*-form, the ♀ progeny was in one case 2 *cenea* only, and in the other 6 *cenea* and 1 *trophonius*.

With all this discrepancy, however, there stands out—as has been well demonstrated by Prof. Poulton (*l. c.*, p. 430)—the constant feature of the immense preponderance of the *cenea*-form in these six results; and with this may be compared the preponderance of the *mima*-form (like the *cenea*-form of the Papilio itself a close mimic of *Amauris albimaculata*) in the three cases of *Euralia wahlbergi-mima* progeny reared by Mr. Millar.

Since I became aware of the occasional pairing of the Natalian *Euralia wahlbergi* and *mima*, I have been surprised at not finding in collections any examples more or less combining the features of the two forms; indeed,

* See Prof. Poulton's "Heredity in six families of Papilio Dardanus, Brown, sub-species *cenea*, Stoll, bred at Durban, by Mr. G. F. Leigh, F.E.S." (Trans. Ent. Soc. Lond., 1908, p. 429).

even an ordinary amount of variation seemed scarcely to occur in either of them to any noticeable degree. The only marked instances of variation I came across were those recorded by me (as "Var. A") in "S.-Afr. Butt.," I, p. 285 and footnote (1887) as of a ♂ and a ♀ of *E. mima*, in which the enlarged white spots of the forewings and the almost white merely yellowish-edged patch of the hindwings showed an approach in the direction not of *wahlbergi*, but of the West-African *dubia*, Palis., and of the Madagascar *E. drucei*, Butl., considered by Aurivillius * to be a variety of *dubia*. But Mr. A. D. Millar, having lately written to me that he possessed an example uniting the characters of *wahlbergi* and *mima*, I replied pointing out the interest attaching to it; and he has now forwarded an excellent photograph by Mr. D. James (see Plate LXV) of this intermediate individual—apparently a ♀—side by side with bred examples of the *wahlbergi* and *mima* forms. It will be seen that while in the forewings this specimen in the main agrees as to its chief markings with *wahlbergi*, the inner-marginal white patch is reduced by its lower half being much clouded with fuscous scales (the submedian nervure being broadly clouded with black); and that in the hindwings the white area is greatly reduced to the size and shape of that in *mima*. Besides this, in both fore and hindwings appears the sub-marginal series of rounded white spots so characteristic of *mima*, but never present in *wahlbergi*. Moreover, Mr. Millar points out that while the blue iridescence characteristic of *wahlbergi* is retained in the forewings, there is a slight tinge of the ochrey-yellow of *mima* on the reduced white patch of the hindwings. The rarity of examples partaking of the characters of both mimetic forms of this sub-species of

* Aurivillius (Rhop. Aethiop., p. 150, 1899) queries whether *E. diffusa*, Butl., of Madagascar (figured by Mabille in Grandidier Madag. Lep. I, pl. 18a, f. 4, 1885–7) be not a "hybrid" between *E. drucei* and *E. madagascariensis*, Mab. (a form close to *wahlbergi*); and also whether *E. daemona*, Staud., from Camaroon ("Iris," IX, pl. 2, f. 1, 1896) be not similarly a "hybrid" between *E. dubia* and *E. anthedon*. Of the latter case I can give no opinion, not having seen Staudinger's figure; but Mabille's figure of the Madagascar *diffusa* does certainly much resemble the photograph of Mr. Millar's example uniting the features of *mima* and *wahlbergi*—the forewings being almost identical, but the hindwings differing conspicuously in the whitish space being very much larger—scarcely less than in *madagascariensis* or *wahlbergi*.

Euralia is in contrast to the comparative frequency of linking intergrades among the polymorphic mimetic forms of the ♀ *Papilio dardanus* throughout all the sub-species of that extraordinary butterfly; and it is the more noticeable because in the *cenea* sub-species of *P. dardanus*, inhabiting the same districts as the *Euralia* under notice, the two more numerous mimetic forms shown by the ♀ (*cenea* and *hippocoon*) simulate respectively the very same species of *Amauris*—viz. *A. albimaculata* and *A. niavius* sub-sp. *dominicanus*—that are the models of the *Euralia*.

As already indicated above (p. 499) *E. wahlbergi* and *E. mima* are very closely-allied south-eastern representatives of the western and equatorial *E. anthedon* and *E. dubia* respectively, and there can be little if any doubt that the latter will be proved, as the former have been, to be two co-existing forms of one species, usually if not always present in the offspring of a single mother of either form. Valuable evidence in this direction has already been furnished by three West-African examples—kindly brought to my notice by Prof. Poulton in the collections of the Hope Department of the Oxford University Museum—intermediate between *anthedon* and *dubia*. The first of these from the Lower Niger (W. A. Forbes) is much closer to *dubia* than to *anthedon*, the median white macular band of the forewings being situate as in *dubia* but much enlarged and with its component spots confluent; some of the white spots of the submarginal series are absent. The second, from the Gaboon (Mark L. Sykes, *circa* 1888) is nearer *anthedon*, but in the forewings the large inner-marginal pale space is obscured with dull violaceous-blue except for a good-sized elongate white spot between 1st and 2nd median nervules, while the sub-apical white bar is as clearly defined and fully developed as in normal *anthedon*; and in the hindwings the white area is somewhat restricted and externally tinged not with the usual blue gloss but with ochrey-yellow (as sometimes in *dubia*): in both wings the submarginal white spots are only partly represented, but those present though obscured with dusky scaling are enlarged. The third, from Camaroon, is in pattern generally like the second, but the colouring is very mixed: in the forewings the sub-apical bar is inferiorly much obscured with black irroration; the upper part of the inner-marginal patch is larger than in the second example and of a purer white, but all its lower part is clouded with obscure ochrey-

yellow; while in the hindwings the pale area is of a clear ochrey-yellow (as in *E. mima*) but radiates strongly outwardly, more especially along the inner-marginal border.

The figures (uncoloured) of the larva and pupa of *E. dubia*, var. *cerberus*, Auriv., from Camaroon, published by Aurivillius (Ent. Tidskr., 1894, t 4, ff. 4, 4a, and 4b) are smaller than the full-grown specimens of those of *E. mima* and *E. wahlbergi* that I have received from Mr. Millar, but they and the brief description (p. 282) agree pretty fairly with the specimens in question. As, however, the account of arrangement of the larval spines (which the author shows to be singularly identical with that exhibited by the larva of *Salamis anacardii*, L.) is not quite complete enough for comparison, I will add here what I have found to be the spinous armature both in *E. wahlbergi-mima* and in *E. deceptor* larvae. Head with a pair of two long, stout, rather clavate and expanded (more distinctly so in *deceptor*), divergent horns on vertex; these horns are moderately spinulose and also sparsely bristly, and bear three or four spinules at the tip. The first thoracic segment bears dorsally, one on each side of median line, two very short slender processes, each terminating in a long fine bristle, and also four rather short rigid spines finely spinulose throughout and tapering to a sharp point—two (upper and lower) on each side; and the second and third thoracic segments each bear in addition (in place of the slender processes on the first segment) a pair of longer dorsal spinulose spines. The abdominal segments each bear an *additional* acute similar spine on median dorsal line, making seven in all on each segment, except the last, which—more or less injured in the inflated dried specimens—appears to bear only five, but has the medio-dorsal spine placed far forward of the rest, close to the front edge of the segment (as Aurivillius mentions in his description of the *Salamis anacardii* larva). Besides the conspicuous spines above-named, there are on each segment quite low down, at base of legs and pro-legs where these occur, two very short blunt spinulose spines, one in advance of the other, both pointing downward.

The colour of the larva in final moult is velvety-black; each segment bears anteriorly a narrow elevated or thickened pale-yellowish transverse band or half-ring, from which spring the from four to seven brownish-yellow spines. The head, legs, and pro-legs are all brownish-

yellow; on the head the horns on the vertex are of the same colour, but the prominent simple eyes are conspicuously black with large white centres. This description applies also to *E. deceptor*, except that in that form the cephalic horns of the last stage are black, and the elevated pale-yellowish segmental half-rings are less regular and defined, being partly interrupted and discontinuous between the expanded bases of the spines.

All naturalists will value the very interesting and important contribution that has been made by Mr. Millar to insect bionomics by his persevering and well-directed experiments, and will join me in congratulating him, and in wishing him continued success in prosecuting his intended further researches into the life-history and genetic conditions of *Euralia*, and also in extending them to other kindred problems that await solution among the Lepidoptera of Africa.

Explanation of the Plates.

Plate LXI.

Euralia deceptor, Trim.—Offspring (68 ♂♂ and 55 ♀♀) bred—2nd to 14th May, 1909—from eggs laid by two "small, apparently dry-season" ♀♀, captured while ovipositing at Mount Edgcumbe, near Durban on 21st March, 1909.

[From a photograph by Mr. J. H. Burn.]

Plate LXII.

Euralia wahlbergi, Wallengr. — Offspring (3 *wahlbergi*-form —2 ♂♂, 1 ♀; and 5 *mima*-form—4 ♂♂, 1 ♀) bred—24th to 29th April, 1909—from eggs laid by a single ♀ *wahlbergi* captured while ovipositing near Durban on 21st March, 1909.

[From a photograph by Mr. J. H. Burn.]

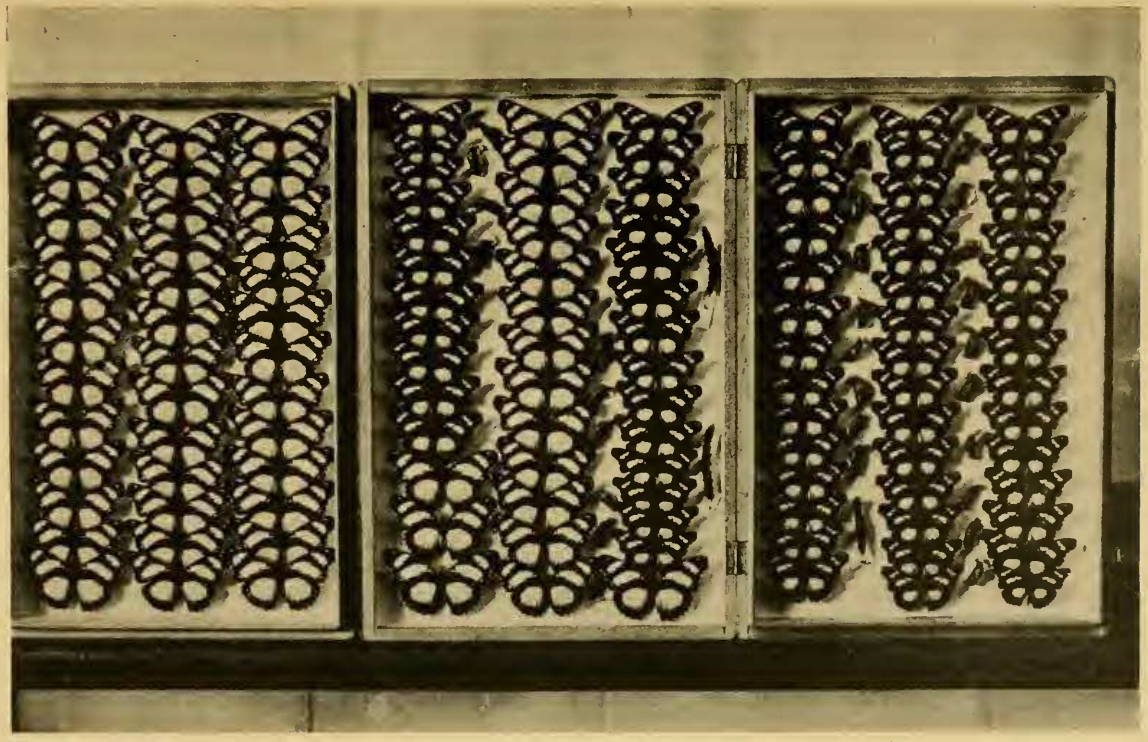
Plate LXIII.

Euralia mima, Trim. (= second form of *E. wahlbergi*, Wallengr.) —Offspring (24 ♂♂ and 9 ♀♀, all of true *mima*-form) bred—6th to 17th May, 1909—from eggs laid by a single ♀ *mima* captured near Durban about 26th March, 1909.

[From a photograph by Mr. J. H. Burn.]

Plate LXIV.

Euralia mima, Trim. (= second form of *E. wahlbergi*, Wallengr.) —Offspring (8 *mima*-form—5 ♂♂, 3 ♀♀; and 3 *wahlbergi*-form



Photo, J. H. Burn.

Offspring (68 ♂ ♂ and 55 ♀ ♀) from ova of two *Euralia deceptor* laid on 24th and 25th March, 1909.